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Solid WASTE Sand re-use from Swedish Metal Casting

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Abstract

Swedish casting and foundry industry has a deep experience from re-using form sand in different applications throughout society, ranging from attempts with closed loop recycling to secondary uses for road construction and other uses in other industrial sectors. From the perspective of the casting and foundry industry, waste sand is piling up after it has been used as forms for casting. From the environmental point of view, the casting is contaminated by the resins used to stabilize the sand. This fact leads to that the waste sand needs to be monitored to avoid to be classified as hazardous waste according to Swedish environmental legislation. Hence, a general industrial vision is to close the loop of the material used for casting forms, since the linear use of sand is both economically significant and environmentally unsustainable. Swerea SWECAST and the Swedish Foundry Association, which is an association of most foundry companies in Sweden, has been working for many years in different projects to find an environmentally beneficial offset for the waste sand. For many of the waste sand categories there are today many acceptable offsets. This has led to a more practical way to view the waste sand, has led to several new waste sand treatment methods to reduce the contaminants, and has led to new practical re-uses of the waste sand. This leads to substantially smaller amounts of solid waste. Future challenges are to 1) use life cycle assessment to compare alternative ways to solve the needs where sand is now being re-use, 2) apply long-term eco-efficiency analyses of linear and circular re-uses of sand, as well as 3) further research to find circular techniques and materials for casting forms, to move away from the need to continuously extract, transport and use a virgin natural resource.

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Keywords: Foundry, casting, sand re-use, circular;

1.0 Introduction

1.1 Background

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Traditional metal casting use sand forms. The quality of the sand is important for the forms to support the casting production and to give the right shape to the cast product. Hence sand with appropriate quality is a crucial resource for the foundry industry. Different types of sand have different desirable properties appropriate for different types of casting. To bind the sand together into the desired form, bentonite or an organic resin is used as binder. After the metal has turned solid in the sand form the form is destroyed and the cast product is knocked out for cleansing and further processing. Both due to the remaining binder in the broken sand forms, and to the wearing and consequential quality degradation of the sand, the sand cannot be immediately reused to create new sand forms. This leads to that large amounts of sand eventually being considered as waste from the foundries. Due to the content of organic binding material the sand is also emitting PAH, and has a potential metal content. The used foundry sand therefore needs to be carefully monitored to avoid to be classified as hazardous waste according to Swedish environmental legislation, with potentially high consequences to waste management requirements and costs. Largely because of this, there is a strong interest in the foundry industry to minimize these waste streams. Much efforts has been done to recycle the sand internally in the foundries, and today the average internal recycling rate of sand is 80-98%. But even with this high recycling rate, there still is about 400 000 tonnes of surplus sand being left for waste land fill in the Nordic countries and Sweden.

This fact does not only represent a substantial comes substantial economic cost for the foundry industry. It also represents a continuous exhaustion of available land area to use for waste management. It also represents a steady and wasteful extraction and transport of the natural resource sand.

The fact that the used form sand is categorized as waste depends first of all on its inappropriateness as form sand. But the sand also potentially contains organic substances that leads VOC and PAH emissions, may be mixed up with bentonite, and may potentially contain metals and other contaminants from the foundry processes.

With so many potential unknowns and possible hazards it is hard to identify interested users or applications of the waste sand. Therefore the key to even considering using the sand is to systematically acquire knowledge, about the quality, the constituents, and about the physical and chemical properties of the sand. This needs to be done both with the sand in itself, and in laboratory and fields tests set up for the specific intended applications. By doing so, the sand from different foundries may be identified as well-specified products or resources for secondary applications rather than as hazardous waste.

When the sand that is no longer suitable for casting forms, but can be categorized as a well-defined product, with a well-monitored and well-known list of constituents it can be considered for different second uses. This is the type of knowledge building and categorization that the Swedish casting and foundry industry has been establishing a deep experience from. By industry relevant and well-organized projects much expertise has been built up about re-using form sand in different applications throughout society.

This paper presents two projects aimed at developing secondary applications of foundry sand, both of which are aimed at waste management applications; 1) for use as ground barrier against wet leakage from land fill sites, and2) for use as structural constituent in organic waste composting. Similar projects have been run for other applications, such as using the sand to strengthen the carriage capacity of peat grounds to support construction on roads over peat areas, as well as for ground foundations for other types of constructions.

1.2. Approach

This paper summarizes two different industry based projects that exemplifies how Swedish and Nordic foundry industries work to minimize sand waste and to find secondary use of the quality degraded sand. Two success factors can be identified for the projects. The first factor is, as has already been mentioned in this paper, to give emphasis and to allocate resources to acquire knowledge and to categorize the properties of the waste sand, and to test its physical and chemical properties in its intended application. The other success factor is to have targeted the intended applications already at project definition. Both these success factors enabled formation of good consortiums, especially including relevant foundry companies and relevant waste management companies.